Chapter 20
Example Problems

1. How long does it take electrons to drift from a car battery to the starting motor? Assume the current produced by the electrons drifting through the circuit is 300 A and the electrons travel through a copper wire with cross-sectional area 0.21 cm^2 and length of 0.85 m. The number of charge carries per unit volume is 8.49 x 10^{28} m^{-3}.

2. A circuit contains a battery and a resistor of resistance *R*. For which one of the following combinations of current and voltage does *R* have the smallest value?
   a. $V = 9$ V and $i = 0.002$ A
   b. $V = 12$ V and $i = 0.5$ A
   c. $V = 1.5$ V and $i = 0.075$ A
   d. $V = 6$ V and $i = 0.1$ A
   e. $V = 4.5$ V and $i = 0.009$ A

3. A coil is formed by winding 250 turns of insulated 16-gauge copper wire (diameter = 1.3 mm, $\rho = 1.69 \times 10^{-8}$ Ωm) in a single layer on a cylindrical form of radius 12 cm. What is the resistance of the coil? Neglect the thickness of the insulation.

4. The legend that Benjamin Franklin flew a kite as a storm approached is only a legend- he was neither stupid nor suicidal. Suppose a kite string of radius 2.00 mm extends directly upward by 0.800 km and is coated with a 0.500 mm layer of water having resistivity 150 Ωm. If the potential difference between the two ends of the string is 160 MV, what is the current through the water layer? The danger is not this current but the chance that the string draws a lightning strike, which can have a current as large as 500,000 A (way beyond just being lethal.)

5. A student kept his 9.0 V, 7.0 W radio turned on at full volume from 9:00 PM to 2:00 AM. How much charge went through it?